

Using a Natural Element Marker to Determine the Source of Beryllium in Surface Swipe Samples

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November 2, 2010**

This work was done by National Security Technologies, LLC, under Contract No. DE-AC52-06NA25946 with the U.S. Department of Energy

Overview

- A method to determine whether beryllium (Be) components in surface swipe samples are from a natural source is needed
- Soil samples and surface swipes from area facilities were analyzed for marker elements to differentiate source pathways for Be
- To be useful, the natural marker element
 - Must be present at reasonably consistent levels across areas of concern
 - Must correlate with the Be concentration
 - Must not have the potential to be present from non-natural sources

Release Criteria

- Title 10 Code of Federal Regulations (CFR) Part 850, “Chronic Beryllium Disease Prevention Program,” establishes release criteria for Be contaminated equipment and other items
- The rule requires contractors to clean Be contaminated equipment and other items to the lowest contamination level practicable but not to exceed:
 - 0.2 micrograms (μg) Be per 100 square centimeters (cm^2) for release of equipment to the general public or use in a non-Be area of the facility
 - 3.0 $\mu\text{g}/100 \text{ cm}^2$ Be for release to another facility performing work with Be
 - The concentration of Be in the soil at the point of release, whichever is greater

Marker Elements Analysis

- The research on marker elements used to identify source pathways for Be concentrations demonstrates a clear correlation between Be and yttrium (Y) in natural soils on the Nevada National Security Site (NNSS)
- The Y/Be ratio is proposed as a method to characterize the source of Be in soil and surface swipe samples and to aid in recommendations for follow-up actions

Southern Nevada and California Data – Y/Be Ratios

- USGS Dust Samples from Southern NV and CA
 - Average: 9.2, SD: 2.2
- USGS Sediment Samples, Southern NV
 - Average: 9.2, SD: 3.6
- USGS Western States Native Soils, NV
 - Average: 8.6, SD: 1.9
- NNSS Site-wide Sampling Event
 - Average: 9.0, SD: 3.5
 - Normal Range for Native Soils: 5 - 16
 - Backfill material, silica sand, concrete: most often 5 - 6
- Single Building Sampling Event
 - Average: 9.0, SD: 0.7

Y/Be Ratio Use

- **Natural:** Y/Be ratios within the statistical range established indicate the Be is from a natural source
- **Operational:** Y/Be ratios lower than this range indicate the presence of another Be source, and may then be correlated to alloy, ceramic, or other operational sources by the ratios of copper, nickel, cobalt, uranium, and/or niobium
 - These may be legacy or current activity

Ratio Usage – Swipe Data Review

- **Y/Be Ratio is in the normal range, and Be is present between <0.1 and 0.5 $\mu\text{g}/100\text{ cm}^2$ levels** – Be presence may be attributed to natural sources
- **Y/Be Ratio is in the normal range, and Be is present at a low level** – Be presence may be attributed to natural sources
- **Y/Be Ratio is lower than normal range, and Be is present or above action level** – Be presence assumed to be operational and actions to further clean or restrict access is implemented
- **Y/Be Ratio is higher than normal range, and Be is present or above action level** – Additional investigation may be needed

Building Decontamination and Decommissioning (D&D) Example

- Be Legacy Building D&D project – Pluto Facility
 - Evaluation for current status after asbestos issues were addressed
 - Legacy use areas had been decontaminated
- Swipe samples from both random sampling and bias targeted sampling produced 8 samples with operational range ratios (0 - 5), and 54 with ratios >5
- The low ratio results came from the rooms within the building that had not been cleaned but had utility connections to the shops
- Swipes of dirty areas that were open to the outside had ratios that matched the surrounding natural soils
- Highest ratio samples came from sampling points where the finest and lightest material gathers

Operational Workspace

- An active workspace sampling resulted in floor swipes taken near the entrance doorway matching the natural soils
- The floor sample taken in front of a finger stock cleaning event matching alloy Be source

ID	Description	Be, $\mu\text{g}/100 \text{ cm}^2$	Y/Be
IH-10-0273	Trailer Floor in front of Rack C19 Cabinet	0.195	0.9
IH-10-0274	Trailer Floor in front of Trailer Doorway	0.119	7.9
IH-10-0275	Trailer Floor in the center of Trailer	0.116	9.4
IH-10-0276	Trailer Floor in the back of Trailer	0.119	11.0

Equipment Used for Demo Projects

- Samples demonstrate Be observed is from natural sources
- Note the cab floor samples tend to be the highest, followed by the wheels

ID	Description	Be, $\mu\text{g}/100 \text{ cm}^2$	Y/Be
IH-09-1734	Inside Cab Floor	0.146	9.2
IH-09-1741	Front of Crane	0.115	10.2
IH-09-1742	Left Front Inside Wheel	0.187	9.2
IH-09-1743	Right Rear Outrigger	0.154	8.8
IH-09-1766	Cab Floor	0.232	9.2
IH-09-1768	Cab Floor	0.263	7.5

Usefulness Demonstrated

- The Y/Be ratio provides the correlation needed to make an informed decision regarding Be sources and actions that will both comply with 10 CFR 850 and provide worker protection
- This differentiation is valuable as there is no known correlation between natural Be in soil and Be disease
- Measuring this ratio is not much more difficult than the Be alone, and as such is a cost-effective approach to achieving compliance